

**CLAIMS**

867 Having described the invention that which is claimed is:

868 1. An article of manufacture containing a first chemical composition useful to treat a  
869 second chemical composition dissolved in an aqueous liquid in contact with the exterior surface  
870 of said article:

871       said article is a capsule comprised of a hollow interior, said first chemical composition  
872 enclosed in said hollow interior, and a membrane, permeable to said aqueous liquid, which  
873 maintains said first chemical composition in said hollow interior;

874       said membrane is comprised of at least a first material, a polyurethane-vinyl polymer  
875 dispersion prepared by the simultaneous polymerization of a vinyl monomer and chain  
876 extension of an isocyanate-terminated polyurethane prepolymer in the presence of water, which  
877 is not reactive with, soluble in or a solvent for said first chemical composition, said second  
878 chemical composition or said aqueous liquid in contact with said exterior surface of said  
879 capsule; and

880       said first chemical composition is reactive with said second chemical composition, is  
881 soluble in said aqueous liquid in contact with said exterior surface of said capsule, is not  
882 reactive with, soluble in or a solvent for said first material, and is selected from, enzymes, and  
883 organic and inorganic acids, bases, salts and oxidizing agents.

884 2. The capsule of claim 1 wherein said first chemical composition is selected from the  
885 group consisting of medicines, pesticides, algaecides, herbicides, cosmetics, laundry products,  
886 pigments, polymerization initiators, cross linking agents, viscosity reducing agents and additives  
887 for adjusting the setting properties of hydraulic cement.

888 3. The capsule of claim 1 wherein said first chemical composition is a solid, water-soluble  
889 chemical composition having a particle size in the range of from about 10 to about 60 mesh US  
890 Sieve series.

891       4. The capsule of claim 1 wherein said first material is cross linked with agents selected  
892 from polyaziridines, carbodiimides, epoxies and metal ion cross linkers.

893       5. The capsule of claim 1 wherein said first chemical composition is selected from alkali  
894 and alkaline earth metal halides, oxides, hydroxides, carbonates, bicarbonates, perborates,  
895 peroxides, percarbonates, bisulfates and persulfates.

896       6. A method for controlling the introduction of a first chemical composition into reactive  
897 contact with a second chemical composition comprising:

898              introducing into an environment comprised of at least one aqueous liquid having said  
899 second chemical composition dissolved therein, a capsule comprised of a hollow interior, said  
900 first chemical composition enclosed in said hollow interior, and a membrane, permeable to said  
901 aqueous liquid, which maintains said first chemical composition in said hollow interior, whereby  
902 the exterior surface of said membrane is in contact with said aqueous liquid;

903              permitting said aqueous liquid to permeate said membrane to contact said first chemical  
904 composition enclosed in said hollow interior to produce a solution of said first chemical  
905 composition in said aqueous liquid; and

906              permitting said solution to permeate said membrane to contact said aqueous liquid in  
907 contact with said exterior surface of said membrane to thereby place said first chemical  
908 composition into reactive contact with said second chemical composition; wherein

909              said membrane is comprised of at least a first material, a polyurethane-vinyl polymer  
910 dispersion prepared by the simultaneous polymerization of a vinyl monomer and chain  
911 extension of an isocyanate-terminated polyurethane prepolymer in the presence of water, which  
912 is not reactive with, soluble in or a solvent for said first chemical composition, said second  
913 chemical composition or said aqueous liquid in contact with said exterior surface of said  
914 capsule; and

915        said first chemical composition is reactive with said second chemical composition, is  
916        soluble in said aqueous liquid in contact with said exterior surface of said capsule, is not  
917        reactive with, soluble in or a solvent for said first material, and is selected from, enzymes, and  
918        organic and inorganic acids, bases, salts and oxidizing agents.

919        7.       An article of manufacture containing a first chemical composition useful to treat a  
920        second chemical composition dissolved in an aqueous liquid in contact with the exterior surface  
921        of said article:

922                said article is a capsule comprised of a hollow interior, said first chemical composition  
923        enclosed in said hollow interior, and a membrane, permeable to said aqueous liquid, which  
924        maintains said first chemical composition in said hollow interior;

925                said membrane is a composite material comprised of a first material and a second  
926        material wherein said first material is a supporting matrix for said second material which is fixed  
927        in said supporting matrix;

928                said first material is a polyurethane-vinyl polymer dispersion prepared by the  
929        simultaneous polymerization of a vinyl monomer and chain extension of an isocyanate-  
930        terminated polyurethane prepolymer in the presence of water, and said first material is not  
931        reactive with, soluble in or a solvent for said first chemical composition, said second chemical  
932        composition, said second material, or said aqueous liquid in contact with said exterior surface of  
933        said capsule;

934                said second material is different from said first material, is a particulate, and is not  
935        reactive with, soluble in or a solvent for said first chemical composition, said second chemical  
936        composition, said first material, or said aqueous liquid in contact with said exterior surface of  
937        said capsule;

938                said first chemical composition is reactive with said second chemical composition, is  
939        soluble in said aqueous liquid in contact with said exterior surface of said capsule, is not

940 reactive with, soluble in or a solvent for said first material or said second material, and is  
941 selected from, enzymes, and organic and inorganic acids, bases, salts and oxidizing agents.

942 8. The capsule of claim 7 wherein said second material in the composite material is a  
943 particulate solid having a particle size in the range of from about 1 to about 15 microns present  
944 in the composite material in an amount in the range of from greater than about 0 to about 50  
945 percent particulate solid by total weight of composite material.

946 9. The capsule of claim 7 wherein said second material is selected from silica, calcium  
947 carbonate, titanium dioxide, barium sulfate, calcium sulfate and mixtures thereof.

948 10. The capsule of claim 7 wherein said first chemical composition is selected from alkali,  
949 alkaline earth metal and ammonium halides, oxides, hydroxides, carbonates, bicarbonates,  
950 perborates, peroxides, percarbonates, bisulfates, borates and persulfates.

951 11. The capsule of claim 7 wherein said first material is reacted with cross linking agents  
952 selected from polyaziridines, carbodiimides, epoxies and metal ion cross linkers.

953 12. The capsule of claim 11 wherein said cross linking agent is admixed with said first  
954 material and said second material in an amount in the range of from about 1 to about 5 per cent  
955 cross linking agent by weight of said first material.

956 13. The capsule of claim 7 wherein said composite material is present in said capsule in an  
957 amount in the range of from about 10 to about 50 percent of said composite material by weight  
958 of said capsule.

959 14. The capsule of claim 7 further comprising a third material deposited on said composite  
960 material as an overcoat.

961 15. A method for controlling the introduction of a first chemical composition into reactive  
962 contact with a second chemical composition comprising:

963       introducing into an environment comprised of at least one aqueous liquid having said  
964 second chemical composition dissolved therein, a capsule comprised of a hollow interior, said

965 first chemical composition enclosed in said hollow interior, and a membrane, permeable to said  
966 aqueous liquid, which maintains said first chemical composition in said hollow interior, whereby  
967 the exterior surface of said membrane is in contact with said aqueous liquid;

968        permitting said aqueous liquid to permeate said membrane to contact said first chemical  
969 composition enclosed in said hollow interior to produce a solution of said first chemical  
970 composition in said aqueous liquid; and

971        permitting said solution to permeate said membrane to contact said aqueous liquid in  
972 contact with said exterior surface of said membrane to thereby place said first chemical  
973 composition into reactive contact with said second chemical composition; wherein

974        said membrane is a composite material comprised of a first material and a second  
975 material wherein said first material is a supporting matrix for said second material which is fixed  
976 in said supporting matrix;

977        said first material is a polyurethane-vinyl polymer dispersion prepared by the  
978 simultaneous polymerization of a vinyl monomer and chain extension of an isocyanate-  
979 terminated polyurethane prepolymer in the presence of water, and said first material is not  
980 reactive with, soluble in or a solvent for said first chemical composition, said second chemical  
981 composition, said second material, or said aqueous liquid in contact with said exterior surface of  
982 said capsule;

983        said second material is different from said first material, is a particulate, and is not  
984 reactive with, soluble in or a solvent for said first chemical composition, said second chemical  
985 composition, said first material, or said aqueous liquid in contact with said exterior surface of  
986 said capsule; and

987        said first chemical composition is reactive with said second chemical composition, is  
988 soluble in said aqueous liquid in contact with said exterior surface of said capsule, is not

989 reactive with, soluble in or a solvent for said first material or said second material, and is  
990 selected from, enzymes, and organic and inorganic acids, bases, salts and oxidizing agents.

PCT/US2014/037400